Makuen (G. H.)

THE BREATHING MOVEMENTS IN RELATION TO VOICE PRODUCTION.

BY

G. HUDSON MAKUEN, M. D.,

PHILADELPHIA.

Reprinted from Education, December, 1890.

SURGEON GEN'LS OFFICE
420
LIBRARY

THE BREATHING MOVEMENTS IN RELATION TO VOICE PRODUCTION.

BY G. HUDSON MAKUEN, M. D., PHILADELPHIA.

A RECENT controversy between Sir Morell Mackenzie and Lennox Browne revives the old and much disputed question as to the best methods of breath control in speech and song.

Sir Morell Mackenzie says that "although the abdominal mode of breathing may be the natural method of inhalation, there can, I think, be no doubt that in singing it is not the most effective." "Undoubtedly," says Lennox Browne, "it is the natural method, consequently the most efficient," and so the doctors disagree. I had hoped that Sir Morell Mackenzie, in his reply to Doctor Browne, would give some reasons for his so-called "unorthodox" view of the matter, but this he has declined to do and since I believe so thoroughly in the truth of his statement I may be pardoned for attempting to place it upon a scientific basis.

In the first place, what is meant by "abdominal breathing," and how does it differ from thoracic breathing? It is that form of breathing of which the most marked characteristic is a protrusion of the abdomen during the inspiratory, and a recession of the abdomen during the expiratory act; the protrusion being caused by a contraction of the diaphragm, and the recession by a relaxation of the same muscle, allowing the abdomen to assume its original shape or position. The thoracic form of breathing, on the other hand, is that characterized by a protrusion of the walls of the thorax during inspiration, and a recession of the same during expiration, the protrusion being caused by all those muscles which elevate the ribs and the recession by a relaxation of the same muscles. This latter form may be divided into upper

SURGEON GEN'LS OFFICE
420
LIBRARY

thoracic and lower thoracic, according as the greater motion is in the upper or lower part of the thorax.

We have, then, these three kinds of breathing, abdominal, lower thoracic and upper thoracic; and of course it must be understood that no one of them can exist independently of the other two, but one form may, and generally does, predominate, and it is because of this fact that the forms and their names are made possible.

Sir Morell Mackenzie in the paragraph which I have quoted, makes the words "breathing" and "inhalation" mean the same thing, whereas it should be remembered that the act of inhalation is only a part of the act of breathing. It is true the other part, viz., that of exhalation, is of minor importance so far as passive breathing is concerned, but in the breathing of vocalization, as I shall try to show, it is even the more important of the two.

Let us now try to get a clear conception of what Doctor Mackenzie means, or ought to mean, by the expression "natural breathing." Much confusion in this subject often arises from a misconception of terms, and a lack of a uniformly adopted nomenclature. Natural breathing, it seems to me, may be defined as the easiest possible form of breathing which best subserves its special purpose, under the existing circumstances. Natural breathing, then, means the *easiest* breathing, and to determine which is the natural or easiest form of breathing, we must take into consideration two things, viz., the position of the breather and the purpose for which he breathes. We can readily understand that the outward manifestations of breathing must change with the position of the subject. For example, in the reclining position, when the subject lies upon the back, the abdominal viscera, by virtue of their own weight and the peculiar shape of the posterior abdominal wall, gravitate toward the diaphragm and actually press upon this muscle, and the anterior wall of the abdomen assumes a flattened shape: whereas in the vertical position of the body, these viscera gravitate away from the diaphragm,

downward and outward, and give to the anterior wall of the abdomen a rounded shape. Now it is clear that there must be a difference in the natural breathing of these two positions. In the former position, during sleep for instance, because of the slight pressure upon the diaphragm and the consequent pressure on the base of the lungs, the diaphragm contracts during inspiration, which contraction relieves the lung pressure and causes an elevation of the anterior wall of the abdomen; and during the following expiatory act the diaphragm and other muscles relax and the abdomen resumes its original shape. This is the easiest form of breathing for this position, and therefore the natural form.

Now if we change the subject from the reclining to the standing position there will be a change in the form of breathing, because this position gives to the abdomen an entirely different shape and centre of gravity. The abdomen no longer presses upon the diaphragm, but is already slightly protruded by virtue of its own weight. If the standing position be a passive one the abdominal method will still predominate, but in a lesser degree, the difference being caused by the change of position and the additional effort to stand.

My first conclusion, then, is that abdominal breathing is the natural mode for *passive* processes, and because it fulfills all the conditions, such as living, sleeping, etc., it is *efficient*, but to say as does Doctor Browne, that "consequently" it is the most efficient for singing and speaking is certainly a very peculiar kind of reasoning.

In the first place, singing or speaking requires a vertical position of the body, and this position, as I have shown, is unfavorable to abdominal breathing. Again, singing or speaking is an active process, and requires an active breathing. The singer breathes not for the sake of living, but for the sake of singing. His object is a definite one. He is standing. The abdomen is already slightly protruded, because of its own weight. To protrude it further, would require a vigorous contraction of the diaphragm,

and this I hold, would interfere with the necessary elevation of the ribs. A strong contraction of the diaphragm, when the subject is in the standing position, draws the ribs down and in, and thus renders a full expansion of the chest impossible. It is for this reason that "the abdominal mode of inhalation" is not the most efficient for singing and speaking. The singer must control a certain amount of breath in the simplest and easiest manner. The amount of breath required is sometimes large. The diaphragm is in contact with one-sixth of the lung surface, and the ribs with the remaining five-sixths. Hence it follows that when a great amount of breath is required the thoracic mode of inhalation is absolutely necessary. The greatest expansion must be at the place where there is the greatest amount of lung tissue, and this is in the lower and middle thoracic region, and not in the abdominal region where there is no lung tissue, nor in the upper thoracic, where there is comparatively little.

Anyone who has ever inflated a pair of lungs, after they have been removed from the thorax knows that the increase in size in a vertical direction is almost *nil* as compared with the increase about the circumference. Now the depression of the diaphragm enlarges the chest in a vertical direction only. It also protrudes the abdomen and puts the abdominal muscles on a stretch so that they actually hold the ribs down, and render impossible a full expansion of the chest at the lower thoracic region.

The secret of enlarging the thorax, as everyone knows who knows anything of the anatomy of the thorax, is to elevate the lateral walls, or the ribs, and the contraction of the diaphragm, and its consequent depression, not only does not assist in elevating the ribs, but directly opposes such elevation. A strongly contracted diaphragm acting over the arched surface of the abdominal viscera actually draws and binds down the ribs, making a full inhalation impossible. Therefore the diaphragm does *not* contract strongly in a full inhalation and the abdomen does *not protrude*. On the contrary, the abdominal muscles are rendered

taut by the elevation of the ribs and the abdomen is flattened. I would therefore go further than Sir Morrell Mackenzie and say that not only is the abdominal mode of inhalation not the most efficient for singing, but that it is not efficient at all, because by it a full inhalation, which at times is absolutely necessary in singing, is an anatomical and physiological impossibility. The long rectus muscles of the abdomen when put on a stretch by the abdominal mode of inhalation interfere with the free expansion of the thorax by checking the upward motion of the ribs, and by actually binding them down. Because of the arched shape of the diaphragm, the abdomen extends up under the lower ribs for several inches, and when during a forced expiration the ribs are drawn down and in, they together with the descending diaphragm, tend to force the abdomen out. As the *torso* contracts or diminishes in size at the costal region, it expands or enlarges at the abdominal region.

My second conclusion, then, is that the natural mode of breathing for singing or speaking, or any other active process, is the lower thoracic or costal mode.

Now if we restrict costal breathing by any means whatever, and make it impossible, what do we have taking its place? The abdominal? No, the next in point of ease and efficiency for singing and speaking is the upper thoracic. When the waist is constricted the lungs are not pushed down into the abdomen, but they are forced slightly upward toward the clavicular region, and it is here that the expansion must take place. In this condition of the thorax, as well as in the normal or unconstricted condition, a full inhalation is impossible by the abdominal method. This point is illustrated by women who sing in public. When the costal region is constricted, the clavicular breathing is very noticeable, and it is so because this is the only available breathing left to the singer which is or can be efficient.

It will be observed that in what I have said, the word "inhalation" may be substituted for the word "breathing" in almost

every instance, for I have followed Doctor Mackenzie's example in making them synonymous. This we cannot properly do, however, in treating of the breath in "speech and song," for to the singer and speaker the act of exhalation is much more important than that of inhalation. The singer inhales for the purpose of *ex*haling, and the manner and amount of the inhalation are governed by the kind of exhalation which is to follow.

The failure to distinguish between the breathing of vocalization which is active, and simple passive breathing has ever been a common error. Only a few weeks ago, the principal of a prominent vocal school gave, as proof of the correctness of his method, a description of the natural breathing of his child. He had observed the action of the muscles during simple respiration and concluded that a precisely similar action must take place during vocalization, overlooking entirely the fact that the one must differ from the other. What he saw, of course, was a regular recurring rise and fall of the abdominal walls, due to the alternate contraction and relaxation of the diaphragm and attended, perhaps, by a very slight simultaneous rise and fall of the thoracic walls, each rise marking the inspiratory, and each fall the expiratory act, and the two together constituting what is known as simple passive respiration or breathing.

When vocalization begins, however, this form of breathing necessarily changes and gives place to an entirely different form. Instead of the gradual prolonged inspiration, due to reflex muscular contraction, we have a quick, instantaneous, voluntary inspiration; and instead of a simple, passive expiration, due to the resilience of lung tissue and muscular relaxation, we have what may be called a vocalized expiration, and this presents a certain definite mechanism which I shall now consider.

Vocalized expiration, or what is the same thing, voice production, is essentially muscular in its processes. Voice is not the result of the mere passage of breath through the approximated edges of the vocal bands, but it is the result of well defined and

characteristic muscular contractions which control the breath and influence the entire physical structure. In a certain sense the whole body becomes a vocal instrument, of which the entire muscular system is the controlling power.

I shall not attempt to enter into any detailed description of all the vocal processes, but confine myself to a few of the more important which have come under my own observation and experience, as a student and teacher.

I find the one disputed point to be the precise action of the diaphragm and abdominal muscles, in voice production, and this is a question, it seems to me, concerning which there should be no doubt. The function of the smaller muscles of the larynx and mouth it is well to understand, but how very important to know the exact function of those larger muscles of the trunk, which may be said to constitute the motor power of the vocal machinery.

It is not generally understood, that the thorax is a resonator of the voice, just as are the mouth and larynx, and the function in part at least, of all those great muscles which surround the thorax, is to give to it a certain oneness of position with all the other resonators, thus assisting to make a combination which has been called the most perfect of all musical instruments.

The thorax is cone-shaped and has a movable and muscular base, the diaphragm, which descends with each contraction and rises with each relaxation. The position of the diaphragm is also determined, to a great extent, by the action of the abdominal muscles, which in point of motion, exactly oppose the action of the diaphragm. It is well known and capable of the most accurate demonstration, that the diaphragm contracts and therefore sinks in passive inspiration, and relaxes and rises in expiration, thus alternately lengthening and shortening the thorax, but to conclude as does our friend the school teacher, that because the diaphragm relaxes in passive expiration, it also relaxes in the production of voice, is to conclude rashly and without sufficient evidence.

In the production of voice it is not the function of the diaphragm and abdominal muscles to force breath out of the lungs, but rather to sustain and control the breath in the lungs, and to assist in giving to the thorax a certain degree of drum-like tension. Just as the drummer tightens his drum strings, so the vocalist contracts his thoracic and abdominal muscles, and for the same reason.

This muscular action may best be explained, perhaps, by taking the production of a single prolonged tone. There are two distinct processes, first, that of preparation, and second, that of actual tone making. The preparatory process is similar to that which naturally takes place just prior to any other muscular act, as lifting a weight or striking a blow, and consists simply in taking in the requisite amount of breath, by means of the contraction of the inspiratory muscles. The ribs are thus elevated, and the diaphragm slightly depressed. The second process, or that of actual production of tone now follows, and consists, not as many would have us suppose, in a complete relaxation of these inspiratory muscles, allowing the ribs to fall to their original position and the diaphragm to rise, but in a further contraction of these same muscles, and a simultaneous contraction of the expiratory muscles. Thus we have two distinct sets of opposing muscles. One is the thoracic set, proper, the inspiratory tending to elevate the ribs and the expiratory tending to depress them, and the other set we shall call the abdominal set, the diaphragm tending to protrude the abdomen and the abdominal muscles tending to check this protrusion. Now it is the nice adjustment of these latter two forces which gives to the thorax that degree of tension upon which the accuracy of breath-control so much depends.

The diaphragm, the chief of the respiratory and vocal muscles, and well worthy the title "Nobilissimus," given it by the ancients, has been the subject of more discussion than any other muscle of the body, and yet its exact function in the production of voice as never yet been clearly set forth. Is this muscle relaxed and

forced up into the chest cavity by means of the contraction of the abdominal muscles and breath in a wholesale manner forced from the lungs? This is the theory of many, and yet if practised closely, it must lead to very disastrous results, disastrous alike to voice and to individual. Someone has well said, "a certain definite amount of breath is required to produce a good tone and any more or any less will injure the tone." How delicate, then, must be the control of these strong muscles, and with what mathematical precision must they do their work. This delicate and precise action is made possible only by that very ingenious principle of opposing forces to which I have already referred.

When the abdominal muscles are contracted, the abdominal viscera form a convex, resisting surface, over which the diaphragm contracts, and as the fibers of the diaphragm radiate from the centre toward the periphery, where they are attached to the lower ribs, the force of the contraction is expended, first, in compressing and slightly depressing the resisting abdomen, and, second, in drawing the ribs in toward the centre and thus diminishing the circumference of the lower part of the thorax. It is the drawing down of the ribs and the formation of a firm thoracic base that is important, and this can be accomplished only when the diaphragm and abdominal muscles act conjointly, as described above, and then because of their peculiar mechanical relations and insertions, the sum of the two forces, and not the difference, is expended in controlling the thoracic walls and so, indirectly, controlling the breath. The abdominal viscera form an arched fulcrum over which the diaphragm draws toward the centre, and the strongest tone is made with a most vigorous contraction of both diaphragm and abdominal muscles, and because of the arched shape of the former muscle it apparently has the greater power, and the result is a slight protrusion, or swelling out of the lower part of the abdomen, while the upper part of the abdomen and the lower part of the thorax are depressed and drawn toward the centre. This action is well observed in some of the lower animals, when they

produce their voice, or characteristic sounds. A decided swelling out of the abdomen is noticed in the cow, for example, when she bellows.

The objection is brought forward that the contraction of the diaphragm must lengthen the thorax, but this is not necessarily true, for if the force with which the abdominal muscles contract be made a little greater than the diaphragmatic force, the contracted diaphragm may be slightly elevated, and this is just what does take place at or near the end of a prolonged tone. When, however, the tone is not greatly prolonged, the diaphragm does not rise relatively to a fixed point in the thoracic structure, but on the contrary, at the very beginning of the tone, it contracts and actually descends, while at the same time, because of the disposition of its fibers, it draws the lower part of the chest walls down and in. This downward and inward motion of the ribs, a most important element in the mechanism, is utterly impossible without a corresponding downward motion and inward contraction, if I may so express it, of the diaphragm. It is true the thorax is slightly lengthened by this process, but this is advantageous in two respects: first, it prevents the forcing of too much breath by these strong muscles, and, second, it allows the lungs to gravitate slightly downward and thus prevents a crowding of the more delicate vocal organs situated just above. The larynx and the trachea with its branches, the bronchi and bronchial tubes, and the lobes and lobules which constitute the lungs, are suspended from the hyoid bone, and a clear, musical tone can be emitted only when these important organs occupy their normal position. If the diaphragm be forced up, by means of the abdominal muscles, the lungs must be driven toward the upper part of the thoracic cavity, and the trachea and larynx crowded and twisted out of all proportion. In order to preserve equilibrium this upward motion of the thoracic viscera is opposed instinctively by a vigorous contraction of the large muscles about the neck, and this results in an enormous compression of the larynx. It is this

compression or constriction of the larynx which is so disastrous to the vocalist, for a clear, ringing voice cannot be emitted from a constricted throat. To avoid this difficulty, we must teach that the diaphragm is the chief muscle of vocalization, and should be the first to act in vocalized expiration or in the production of voice. The abdominal muscles follow and resist the action of the diaphragm. The abdomen is protruded, and not depressed, and thus the thoracic viscera and larynx are given ample room to perform their function, which function, in point of force, is a comparatively passive one.